GP RESPONSES TO PRICE REGULATION: EVIDENCE FROM A FRENCH NATIONWIDE REFORM

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SUMMARY

This paper uses a French reform to evaluate the impacts of overbilling restrictions on general practitioner (GP) care provision, fees and incomes. Since 1990, this reform has introduced conditions self-employed GPs must fulfil to be permitted to bill freely. We exploit 2005 and 2008 public health insurance administrative data on GP activity and fees. We use fuzzy regression discontinuity techniques to estimate local causal impacts for GPs who established practices in 1990 and who were constrained by the new regulation to charge regulated prices (compliers). We find that those GPs practices to income effects. In the regulated fee regime, GPs face prices lower by 42% and provide 50% more care than they would do in the unregulated fee regime. Male care provision increasing reaction is larger than the female one, which results in a higher male labour income in the regulated fee regime than with unregulated fees, whereas it is the opposite for women. With regulated fees, GPs limit side-salaried activities, use more lump-sum payment schemes and occupy more often gatekeeper positions.

1. INTRODUCTION

Physician strategic responses to price regulation are of major concern for public policies, as they may have dramatic consequences for care provision, thus, potentially affecting access to care in low medical density areas, and impacting national health accounts. These responses vary depending on physician preferences. For example, in response to fee cuts, the volume of care provided by physicians may increase (physicians work more to offset their decrease in income) or decrease if the Hicksian price substitution effect dominates the income effect (physicians substitute leisure for consumption as the relative price of leisure decreases). The specific French fee-for-services (FFS) system, in which both free-billing and regulated-fee general practitioners (GPs) coexist and can deliver the same services, provides an interesting setup to examine this question. In December of 1989, a reform introduced conditions that GPs must fulfil to be permitted to bill freely. This induced a discontinuity in the proportion of free-billing GPs among new GPs establishing practices. We use this change in regulation to examine the effects of price regulation, which here consists of overbilling restrictions. By applying fuzzy regression discontinuity (FRD) techniques (Hahn \textit{et al.}, 2001; Imbens and...
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Lemieux, 2008; Lee and Lemieux, 2010) to 2005 and 2008 public health insurance (PHI) administrative data, we estimate local causal effects in terms of care provision, fees, incomes and other specific dimensions of GP practice.

Neither theoretical nor empirical literature comes to a consensus on how physicians should react to price regulation. Utility-maximizer physicians (who value leisure) who can discriminate among patients by price may provide less care than they would if they were practicing with regulated fees (McGuire and Pauly, 1991; Rizzo and Blumenthal, 1994; Thornton and Eakin, 1997). However, they may provide the same volume of care under both regimes if they are simply profit maximizers. Less care provision may be detrimental in cases of previous rationing, but may be more efficient if, under price regulation, physicians induce demand (see (Evans, 1974) for seminal work and (Delattre and Dormont, 2000, 2003) for empirical evidence for French data). Further, discriminating both on the pricing and quality of services may generate efficiency benefits by increasing both the quality of care offered to patients who are charged extra fees and to those who are not, as in the Medicare context (Glazer and McGuire, 1993; Kiffman and Scheuer, 2011). Nor do empirical studies offer any consensus on this issue either, probably because these studies examine countries with very different contexts of care regulation. For the US case, physicians did not alter their behaviours much in response to Medicare balance-billing restrictions (McKnight, 2007). Other studies by contrast find that physicians respond to fee cuts by intensifying their activities and focusing on the most intensive procedures; regarding surgeon specialists in the USA, (see (Yip, 1998) regarding surgeon specialists in the USA and (Rochaix, 1993) and (Nassiri and Rochaix, 2006) for Canadian GPs).

In line with the latter studies, we find strong reactions to income effects: the GPs who were constrained by overbilling restrictions included in the reform to charge regulated prices (compliers) were driven to provide much more care (+51L%) when facing lower prices (−42L%) than what they would have done if they had been permitted to bill freely.1 The increase in care provision by male GPs under the regulated fee regime (with respect to the unregulated fee scheme) exceeds the corresponding increase for female GPs. Ultimately, with regulated fees, male GPs have higher labour income than under unregulated fees, whereas it is the opposite for women. Under price regulation, GPs are more accessible to patients, as 60% of the additional activity is directed to new patients. However, regulation may also induce demand, as the remainder is attributable to more frequent visits from regular patients. Price regulation also appears to ensure ambulatory care continuity: more gatekeepers, more night or weekend shifts and on-call duties by male GPs. Moreover, GPs increase their use of complementary remuneration schemes through capitation (lump-sum payments), but not their salaried activities. Further, price regulation results in changes among patient groups that are consistent with increased accessibility to ambulatory care.2 A complementary analysis suggests that short-term effects (especially on activity) may be larger than those presented here based on 2005 and 2008 data.

The paper proceeds as follows. Section 2 describes the data. Section 3 examines the regulation of physician fees in France. The empirical strategy is presented in Section 4. Section 5 reports on the main results, and Section 6 presents a final discussion.

2. DATA

Our empirical analysis relies on an exhaustive administrative INSEE-CNAMTS-DGFiP File on physicians. The richness of this data set enables us to study detailed dimensions of GP practice. This data set merges individual information on activity provided by the PHI (Caisse Nationale d’Assurance Maladie des Travaillleurs Salariés, CNAMTS) and individual information on earnings based on household tax income declarations. It covers the entire GP population for 2005 and 2008. In our main analysis, we do not exploit the panel structure of the data and, instead, pool the two waves.

1 Most of our results on relative changes (from x to y) are reported in log percentages (100 log(y/x), denoted as L%) (Tornqvist et al., 1985). For infinitesimal changes, L% can be approximated by %.

2 With a potential redistribution of patients from hospitals.
We focus on GPs who opened their private practices between 1983 (7 years before the reform) and 1996 (6 years after). We exclude those practicing overseas, those who did not sign a contract with PHI (fewer than 1% of GPs) and those who declared that they follow a particular mode of practice (such as acupuncture, homoeopathy and allergy services), as their services may differ from those offered by other GPs and are not always reimbursed on the same basis. Further, we exclude GPs aged 60 years or older who receive pensions or annuities. The latter engage in very limited or heterogeneous self-employed activities and are not comparable with the others. Finally, our sample consists of 45 537 pooled observations for 2005 and 2008.

3. REGULATION OF GP PAYMENTS IN FRANCE

3.1. Coexistence of regulated-fee and free-billing GPs

In the French primary care system, which mainly relies on an FFS payment system, regulated-fee and free-billing GPs coexist and offer the same services. Indeed, as of 1980, physicians can sign contracts with PHI in sectors 1 or 2. Sector 1 GPs must apply fixed grid prices, referred to as regulated or reference prices, for most of their services and for any patient. They are not permitted to bill freely. By contrast, sector 2 GPs freely set prices for any service and for any patient within ‘ethical’ limits – they must price with ‘tact and moderation’ (‘tact et mesure’) and they are not permitted to charge extra fees to low-income patients. In exchange, PHI subsidizes a proportion of sector 1 GP social insurance contributions and pension savings, whereas it does not do so for sector 2 GPs. As an example, in 2008, a sector 2 GP office visit was priced at €34 on average (standard deviation = €12.6) vs €22 for a sector 1 GP visit.

On the patient side, patients freely choose to consult a sector 1 or 2 GP and can change physicians at any time. The sector to which a GP belongs and the fees he or she charges are public information. Regardless of the sector of the GP, PHI will always reimburse 70% of the service reference price. The remaining 30% (co-payments) and potential supplements (extra fees) are covered by the patient himself or herself or through private health care contracts. Private healthcare contracts usually cover complements, although coverage levels for supplements vary considerably between contracts.

3.2. Descriptive statistics

The sector 2 contract, developed just before the presidential elections, was adopted to increase physician incomes without affecting national health accounts (Lancry and Sandier, 1999). While practicing in sector 2 has always been financially advantageous, only 10% to 16% of GPs decided to join sector 2 from 1980 to 1989 (Ecosante, 2013). A large proportion of GPs has always been opposed to sector 2, which has been charged with creating two-tier medical care (Hassenteufel, 1997). Hence, choice of sector has always been strongly endogenous, related to individual trade-offs between labour and leisure, and ethical considerations. Sector 1 and sector 2 GP preferences are likely to differ considerably. Both types of GPs also differ with respect to most observable characteristics. See Table I, which reports basic descriptive statistics for GPs who established a practice from 1983 to 1996 (pooled observations for 2005 and 2008). First, female GPs are over-represented in sector 2 with respect to sector 1 (29.4% vs 27%). Sector 1 GPs open practices at a younger age. Furthermore, for medical service prices 34L% lower on average, sector 1 GP activity levels are 40L% higher than those offered by sector 2 GPs, and sector 1 GP annual fees are 8L% higher. Ultimately, sector 1 GP labour incomes are 19L% higher than those of sector 2 GPs.

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3Two-thirds of GPs are self-employed and paid through FFS (Ecosante, 2013).
4In 2012, only 4% of the population was not covered by any complementary healthcare scheme (Garnero and Le Palud, 2013).
5In 1981, GPs opposed to sector 2 formed a board that became the first union specific to GPs in 1985.
6t-tests for equal means are performed for all variables.
7We report log percentages (L%), that is, differences in the log of outcomes for sectors 1 and 2 (Tornqvist et al., 1985). Apart from infinitesimal changes, interpretations of results as percentage points may lead to a misinterpretation of the difference.
8Net incomes after social contribution subsidies.
Table I. Descriptive statistics on sector 1 and sector 2 GPs

<table>
<thead>
<tr>
<th></th>
<th>Sector 1</th>
<th>Sector 2</th>
<th>Equal means test</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>St. dev</td>
<td>Average</td>
<td>St. dev</td>
</tr>
<tr>
<td>Nb of obs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>48.858</td>
<td>4.583</td>
<td>51.598</td>
<td>3.974</td>
</tr>
<tr>
<td>Sh. of women</td>
<td>0.270</td>
<td>0.444</td>
<td>0.294</td>
<td>0.456</td>
</tr>
<tr>
<td>Annual provision of care (in log)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Care provision indicator</td>
<td>11.652</td>
<td>0.609</td>
<td>11.247</td>
<td>0.749</td>
</tr>
<tr>
<td>Nb. of medical procedures</td>
<td>8.471</td>
<td>0.633</td>
<td>8.053</td>
<td>0.751</td>
</tr>
<tr>
<td>Nb. of technical procedures</td>
<td>2.325</td>
<td>1.913</td>
<td>2.418</td>
<td>2.468</td>
</tr>
<tr>
<td>Nb. of office visits</td>
<td>8.261</td>
<td>0.885</td>
<td>7.816</td>
<td>1.060</td>
</tr>
<tr>
<td>Nb. of home visits</td>
<td>5.933</td>
<td>1.527</td>
<td>4.099</td>
<td>2.454</td>
</tr>
<tr>
<td>Nb. of patients</td>
<td>7.249</td>
<td>0.577</td>
<td>6.981</td>
<td>0.765</td>
</tr>
<tr>
<td>Nb. of med. proc per patient</td>
<td>1.489</td>
<td>0.233</td>
<td>1.379</td>
<td>0.291</td>
</tr>
<tr>
<td>Annual fees and incomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average price (in log. €2008)</td>
<td>3.238</td>
<td>0.183</td>
<td>3.577</td>
<td>0.288</td>
</tr>
<tr>
<td>Total fees (in log. €2008)</td>
<td>11.679</td>
<td>0.594</td>
<td>11.599</td>
<td>0.683</td>
</tr>
<tr>
<td>Lump-sum payments (in log. €2008)</td>
<td>8.274</td>
<td>1.375</td>
<td>6.851</td>
<td>2.299</td>
</tr>
<tr>
<td>for on-calls/guards (2008 only)</td>
<td>4.378</td>
<td>3.919</td>
<td>1.713</td>
<td>3.200</td>
</tr>
<tr>
<td>for specific patients (2008 only)</td>
<td>7.197</td>
<td>1.784</td>
<td>4.496</td>
<td>3.180</td>
</tr>
<tr>
<td>Labour incomes (in log. €2008)</td>
<td>11.139</td>
<td>0.590</td>
<td>10.950</td>
<td>0.739</td>
</tr>
<tr>
<td>Sh. of GPs exclusively self-employed</td>
<td>0.930</td>
<td>0.255</td>
<td>0.879</td>
<td>0.327</td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
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<tr>
<td>Sh. of patients for whom the GP is a gatekeeper</td>
<td>0.357</td>
<td>0.174</td>
<td>0.244</td>
<td>0.188</td>
</tr>
<tr>
<td>Annual prescription per patient (in log. €2008)</td>
<td>5.923</td>
<td>0.719</td>
<td>5.342</td>
<td>1.079</td>
</tr>
<tr>
<td>Annual drug prescription per patient (in log. €2008)</td>
<td>5.258</td>
<td>0.795</td>
<td>4.646</td>
<td>1.184</td>
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<tr>
<td>Sh. of female patients</td>
<td>0.556</td>
<td>0.061</td>
<td>0.611</td>
<td>0.106</td>
</tr>
<tr>
<td>Sh. of patients aged 15 years or younger</td>
<td>0.217</td>
<td>0.072</td>
<td>0.157</td>
<td>0.100</td>
</tr>
<tr>
<td>Sh. of patients aged 65 years or older</td>
<td>0.157</td>
<td>0.085</td>
<td>0.161</td>
<td>0.098</td>
</tr>
<tr>
<td>Sh. of CMUC patients</td>
<td>0.094</td>
<td>0.089</td>
<td>0.048</td>
<td>0.049</td>
</tr>
<tr>
<td>Sh. of patients with chronic diseases</td>
<td>0.145</td>
<td>0.060</td>
<td>0.133</td>
<td>0.064</td>
</tr>
<tr>
<td>Sh. of GPs practicing in rural areas</td>
<td>0.177</td>
<td>0.381</td>
<td>0.060</td>
<td>0.237</td>
</tr>
</tbody>
</table>

St. dev, standard deviation; Nb, number; Sh., share; med. proc., medical procedures. *** stands for statistical significance at 1% level.

The care provision indicator denotes numbers of medical procedures of each type weighted by their reference prices. The number of medical procedures is the sum of office visits, home visits and technical procedures. Average price is defined as total annual fees divided by number of medical procedures performed in a year. Total annual fees include fees earned at reference price, extra fees and lump-sum payments. Lump-sum payments for specific patients include lump-sum payments for children and for patients with chronic diseases served as gatekeeper, and some other regulated surcharges. Labour incomes are defined as total annual fees net minus all professional expenses (such as social contributions, office rents, secretarial services, etc.) and wages, if applicable. CMUC patients are low income patients whom GPs are not permitted to charge extra fees.

Source: INSEE-CNAMTS-DGFIP File. Self-employed GPs, who are not retired if older than 60 years, perceiving at least €1 of fees in the observation year. Particular mode of practice excluded. Pooled observations for 2005 and 2008.

Sector 1 and sector 2 GPs also differ in terms of medical services provided. Sector 1 GPs conduct more office visits and significantly more home visits. They also meet their patients more often and prescribe more. In contrast, sector 2 GPs perform more technical procedures. More sector 1 GPs practice in rural areas (17.7% vs 6%). Finally, sector 1 GP patient groups contain fewer women, fewer seniors, more young patients, more low-income patients and more patients with chronic diseases.

Of course, these descriptive statistics do not provide information on causal effects of price regulation, as GPs choose to engage in a sector based on their (unobserved) preferences. We therefore exploit the 1990 ‘Sector-2 freeze reform’ as an exogenous change in the assignment rule to overcome this self-selection issue and identify the causal effect of price.
3.3. The ‘sector-2 freeze’ reform

Facing a constantly rising number of sector 2 physicians (GPs and specialists) without a corresponding increase in the provision of health care, the left-wing government that came to office in 1988 initiated changes in the organization of the supply of health care. Since December of 1989, the ‘sector-2 freeze’ reform has introduced conditions a new GP must fulfil in order to join sector 2 and therefore be able to bill freely. All physicians who established a practice in November 1989 or before could freely choose the sector in which they wished to practice and could switch sectors, subsequently. Since December of 1989, the sector 2 contract has only been offered to physicians who have run a qualifying university teaching and hospital practice for at least 2 years (such as ex-clinic supervisors). Further, physicians can no longer switch sectors at will during their careers, even if they hold the titles required.9

With the new regulation, the proportion of new sector 2 GPs abruptly drops from 1989 to 1990, the first full year of implementation: while 11.2% of GPs who established a practice in 1989 opted for a sector 2 contract, only 0.9% chose this option in 1990 (Figure 1). This discontinuity is unrelated either to GP abilities or to ethical concerns; it depends only on the year in which GPs established their practice. As a consequence of the reform, in 2011, fewer than 7% of self-employed GPs held a sector 2 contract versus 16% in 1990 (Ecosante, 2013). Figure 2 intuitively illustrates the causal effects of price regulation. With overbilling restrictions from 1989 to 1990, the average price of services diminishes. The average volume of care offered increases, whereas no apparent changes in levels of fees occur. In the following, we exploit these discontinuous changes using FRD techniques to identify and estimate the magnitude of these effects.

4. EMPIRICAL STRATEGY

4.1. FRD framework

Let \( W_i \) denote the sector (our treatment variable). \( W_i = 1 \) if physician \( i \) chooses sector 1 and \( W_i = 0 \) if he or she chooses sector 2. Let \( Y_i \) be an outcome of interest. In the Rubin causal model, the potential outcome

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9Sector 2 physicians can choose to enter sector 1 whenever they wish but the reverse is not possible.
of physician $i$ in sector 1 is denoted by $Y_i(1)$ and $Y_i(0)$ in sector 2. The treatment effect on physician $i$ is $\tau_i = Y_i(1) - Y_i(0)$. $\tau_i$ varies between physicians and is unobserved, as only one of the two potential outcomes is observed, $Y_i = W_iY_i(1) + (1 - W_i)Y_i(0)$. The FRD framework enables us to identify the local average treatment effect $\tau$ on the group of GPs who established a practice in 1990 (the date of the reform), who were constrained by the reform to practice in sector 1, but who would have chosen sector 2 if that had been possible (complier group) (Hahn et al., 2001; Imbens and Lemieux, 2008; Lee and Lemieux, 2010):

$$\tau = E[Y_i(1) - Y_i(0)|X = 1990 \text{ and } i \text{ is a complier}]$$

where $X$, the running variable, denotes the year in which a physician establishes a practice. We can rewrite $\tau$ as

$$\tau = \lim_{x \to 1990^+} E[Y|X = x] - \lim_{x \to 1990^-} E[Y|X = x]$$

$$\lim_{x \to 1990^+} P[W = 1|X = x] - \lim_{x \to 1990^-} P[W = 1|X = x]$$
Changes in the average outcome immediately before and after the date of the reform are related to a strictly positive change in the proportion of new sector 1 GPs. In practice, an estimate of $\tau$ can be obtained by estimating

$$Y_i = \tau W_i + h(X_i) + \epsilon_i, \quad i = 1, \ldots, n,$$

where $W_i$ is instrumented by $1_{X_i \geq 1990}$, $n$ is the number of physicians who established a practice in a local bandwidth of years preceding or following 1990, and where $h(x)$ is a very flexible function of $x$, which is continuous at the date of the reform. For example, for a linear specification of $h$ and a bandwidth of 5 years, we estimate

$$Y_i = \tau W_i + \alpha_0 + \alpha_1 (X_i - 1990)1_{X_i < 1990} + \alpha_2 (X_i - 1990)1_{X_i \geq 1990} + \epsilon_i, \quad i | 1985 \leq X_i \leq 1994.$$  

The FRD identification strategy holds under four validity conditions. First, the expectations of the potential outcomes conditional on $X$ are to be continuous at the date of the reform:

$$E(Y_i(0)|X_i = x) \text{ and } E(Y_i(1)|X_i = x) \text{ are continuous in } x = 1990.$$  

Although this condition is not directly testable, we did check that covariates related to outcomes, namely, sex and family status, were continuously distributed in 1990; see the online appendix and technical report (Coudin et al., 2014).

Second, $\tau_i$ and treatment status $W_i(x)$ are assumed to be locally jointly independent of the year of practice establishment $X_i$ (local random assignment assumption):

$$\tau_i, W_i(x) \perp X_i \text{ close to } X_i = 1990.$$  

Condition (6) implies that GPs do not have perfect control over the date at which they establish a practice, even if they do try deliberately to benefit from sector 2. The sector 2 freeze was unanticipated by GPs. Indeed, the agreement on the new rules for practicing medicine in sector 2 was first signed by PHI and a minority union composed largely of specialists (Fédération des médecins de France) and then applied to the population of all physicians. Moreover, if GPs had been able to perfectly manipulate the threshold and quickly establish a practice to avoid being constrained by the reform, we should expect discontinuous changes in the age of GPs at the time practices were established and in the duration from graduation to the date of practice establishment.

Hence, we performed formal tests and accepted that these variables were continuously distributed before and after 1990 (see the online appendix for details). We do not find indications of manipulation.

Third, we assume that no GPs entered sector 2 after the reform was passed and would have entered sector 1 had the reform not been passed. This ‘no defier’ assumption seems quite credible, as only 0.9% of GPs signed a sector 2 contract after the reform, the number of potential defiers must be close to 0.

Finally, our running variable, $X_i$, the year of practice establishment, is discrete. To identify the treatment effect, we must assume that the regression function $h(.)$ is correctly specified (Lee and Card, 2008). We thus pay particular attention to model fit quality by performing goodness-of-fit (GoF) tests (Lee and Card, 2008; Lemieux and Milligan, 2008)). For inference issues, regressions are also clustered by the year of practice establishment to account for some potential specification errors.

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10This is true if the expectations and probabilities of Equation (2) are estimated using the same bandwidths and uniform kernels.
11We do not directly test the continuity of the number of GPs who opened practices each year as is usually done in FRD setups (McCrary, 2008), because this number is quasi-directly deduced from the number of students permitted to pass the first year of medical studies (numerus clausus) 9 years prior (average studies duration). The numerus clausus is strongly discontinuous with no relation to potential manipulation. Moreover, the relative share of new specialists with respect to new GPs remained stable after 1990. Therefore, changes in the number of GPs are not attributable to the fact that more students chose to become specialists in order to access sector 2 after the reform was passed.
4.2. Which effect do we estimate?

Under these validity conditions, the FRD approach enables us to identify and estimate a local causal effect of overbilling restrictions (engaging in sector 1 rather than sector 2) on a specific group: sector 1 GPs who established a practice in 1990 and who would have chosen a sector 2 contract if possible. This complier group accounts for 10.6% of GPs who established a practice in 1990. This proportion is given by the parameter of the instrument $I_{X_{i} \geq 1990}$ in first-stage regressions and can be read from Figure 1.12 This complier group represents a small proportion of GPs with specific characteristics: women and unmarried GPs are over-represented, but compliers have ages similar to the full GP sample. There is no external validity a priori for the results, as the effect of the treatment certainly differs among physicians. The FRD method is, however, advantageous in that, being local, $\tau$ is identified regardless of structural change trends in the GP population, such as processes of feminization, as long as these structural effects were unfolding continuously at the date of the reform. Finally, overbilling restriction effects that we estimate are long-term effects, as the data we use are observed 15 to 18 years after the date of the reform.

5. RESULTS

Table II reports Ordinary Least Squares (OLS) for comparison issues and FRD estimation results for all GPs and for male and female GPs separately. We use a bandwidth of 5 years before and after the reform, and linear, polynomial and linear spline trend specifications with different slopes before and after the date of the reform. In the interest of brevity, we only report results with the best trend specifications according to GoF tests.13 All causal effects interpreted hereafter are local average treatment effects, which apply exclusively to the group of complying GPs.

5.1. Provision of care

Our main outcome variable, the care provision indicator, accounts for the number of medical procedures and their intensity of care. The variable denotes numbers of medical procedures of each type weighted by their reference prices. Facing 42L% lower prices, GPs who were forced by the reform to charge regulated fees increased their volume of activity by 51L% relative to what they would have done under unregulated fees, which is significantly larger than what basic OLS suggest.14 The large increase in the care provision indicator is mainly attributable to more medical procedures: +61L%. GPs who complied with the reform thus react strongly to income effects.15 Male GPs react more (+69L% in activity) than female GPs (+22L%). These effect magnitudes may appear to be large when set against what is usually found in the literature. For example, a 10% rise in the relative prices of caesarean delivery with respect to normal childbirth results in a 8.4% increase in caesarean delivery rates (Gruber et al., 1999), and a 10% reduction in fees results in a 4% increase in the volume of services provided (Nguyen, 1996). The large magnitudes are due to the fact that fee cuts considered here are quite substantial, potentially resulting in drastic behaviour changes in terms of healthcare supply.

More care provision means both an increase in accessibility with more patients seen by each GP (or a redistribution of patients from hospital to ambulatory care)16 and in more intensive follow-up visits. The latter may reflect supply-induced demand mechanisms, a well-known drawback of FFS with regulated fees. The number of patients seen by a GP each year is indeed 40L% higher for both men and women. Consequently, approximately 60% of the additional medical procedures are addressed to new patients, with the

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12 Full first-stage regression results are available upon request.
13 Results are generally stable across non-rejected specifications. See the online appendix for detailed results.
14 This results in a price elasticity of activity equal to 1.27.
15 Under the assumption that the aggregate demand addressed to a GP under price regulation equals that addressed to him or her if he or she perfectly price-discriminates patients above the reference price and if there are no changes in the quality of services provided.
16 Patients may also have redistributed themselves from sector 2 to sector 1. We thus cannot speak of causal effects, as both the treatment and the control group were affected.
Table II. FRD and OLS estimates: GPs establishing practice 5 years before and after 1990

<table>
<thead>
<tr>
<th></th>
<th>OLS All GPs</th>
<th>OLS All GPs</th>
<th>OLS Male GPs</th>
<th>OLS Female GPs</th>
<th>FRD (1) All GPs</th>
<th>FRD (1) Male GPs</th>
<th>FRD (1) Female GPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual provision of care (in log)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Care provision indicator</td>
<td>0.394***</td>
<td>0.510***</td>
<td>0.686***</td>
<td>0.223***</td>
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<td></td>
<td>(0.021)</td>
<td>(0.087)</td>
<td>(0.152)</td>
<td>(0.032)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of medical procedures</td>
<td>0.409***</td>
<td>0.611***</td>
<td>—</td>
<td>0.472***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.145)</td>
<td>—</td>
<td>(0.048)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of technical proc.</td>
<td>—2.16***</td>
<td>—2.72</td>
<td>—2.01</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.070)</td>
<td>(0.251)</td>
<td>(0.157)</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of office visits</td>
<td>0.448***</td>
<td>0.731***</td>
<td>0.668**</td>
<td>0.891***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.204)</td>
<td>(0.332)</td>
<td>(0.109)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of home visits</td>
<td>2.074***</td>
<td>1.509***</td>
<td>2.547***</td>
<td>—0.040</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.067)</td>
<td>(0.125)</td>
<td>(0.151)</td>
<td>(0.319)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of patients</td>
<td>0.249***</td>
<td>0.397***</td>
<td>0.453**</td>
<td>0.371***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.122)</td>
<td>(0.197)</td>
<td>(0.082)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nb. of med. proc. per patient</td>
<td>0.118***</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.089*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>(0.053)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual fees and incomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average price (in log. €2008)</td>
<td>—0.346***</td>
<td>—0.416***</td>
<td>—</td>
<td>—0.475***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.049)</td>
<td>—</td>
<td>(0.034)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total fees (in log. €2008)</td>
<td>0.063***</td>
<td>0.196**</td>
<td>0.360**</td>
<td>—0.046</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.098)</td>
<td>(0.151)</td>
<td>(0.046)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lump-sum payments</td>
<td>1.588***</td>
<td>1.621***</td>
<td>1.939***</td>
<td>0.748*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(in log. €2008)</td>
<td>(0.061)</td>
<td>(0.219)</td>
<td>(0.386)</td>
<td>(0.421)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour incomes (in log. €2008)</td>
<td>0.183***</td>
<td>0.085</td>
<td>0.218**</td>
<td>—0.182*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.089)</td>
<td>(0.099)</td>
<td>(0.095)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh. of GPs exclusively self-employed</td>
<td>0.058***</td>
<td>0.031</td>
<td>—0.008</td>
<td>0.110*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.022)</td>
<td>(0.059)</td>
<td>(0.063)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh. of patients for whom the GP is a gatekeeper</td>
<td>0.135***</td>
<td>0.097***</td>
<td>0.080***</td>
<td>0.037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.020)</td>
<td>(0.026)</td>
<td>(0.027)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual prescription per patient (in log. €2008)</td>
<td>0.653***</td>
<td>0.249***</td>
<td>0.223***</td>
<td>—0.275*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.040)</td>
<td>(0.084)</td>
<td>(0.166)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual drug prescription per patient (in log. €2008)</td>
<td>0.697***</td>
<td>0.403***</td>
<td>0.490***</td>
<td>—0.050</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.033)</td>
<td>(0.115)</td>
<td>(0.156)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F- first stage of excluded instrument</td>
<td>—</td>
<td>1427</td>
<td>1309</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>957</td>
<td>1036</td>
<td>72.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>929</td>
<td>1077</td>
<td>94.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh of obs.</td>
<td>33701</td>
<td>33701</td>
<td>24336</td>
<td>9365</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nb, number; med. proc, medical procedures. Sh, share. ***Statistically significant at 1% level; **significant at 5% level; *significant at 10% level; p significant at 15% level.

This table reports OLS and fuzzy regression discontinuity (FRD) estimates of causal effects of overbilling restrictions on various outcomes, for all GPs (columns 1 and 2) and FRD estimates for male and female GPs separately (columns 3 and 4). We use a bandwidth of 5: the data restrict to GPs who opened practices between 1985 and 1994. Regressions are clustered by the year of practice establishment. OLS: outcome is regressed on a sector un-instrumented dummy and GP covariates (age, age squared, gender, year of starting practice and marital status). Standard deviations are reported in parentheses, below estimates.

Source: INSEE-CNAMTS-DGFIP File. Self-employed GPs, who are not retired if older than 60 years, perceiving at least €1 of fees in the observation year. Particular practice mode excluded. Pooled observations for 2005 and 2008.

(1) We performed FRD with three specifications for time trends: local linear (LL), local quadratic (LQ) and local linear spline (LLS). Only results with the best fitting trend specification and that pass GoF tests are reported (Lee and Card, 2008). The chosen specification is reported in parentheses, next to estimates. See the online appendix for tables with detailed results.
remaining 40% directed to patients who were already enrolled. This increase in accessibility is directed not only to occasional patients, but also to new regular patients, because the share of patients for whom the GP is a gatekeeper increases significantly (+9.7L%).

The additional care provision largely concerns visits: on average, GPs conduct 150L% more home visits under regulated fees and 73L% more office visits, whereas effects on technical procedures, which are often more lucrative, are null or negative. However, the trends differ between men and women. Male GPs complete more home visits (+255L%), women do not. In contrast, even if male GPs conduct slightly more office visits than women, the increase represents a more substantial share of activities for female GPs (+89L%) than for male GPs (+67L%).

5.2. Remuneration schemes

We consider the total fees earned in a year and the average price of a procedure, defined as annual fees divided by the number of medical procedures performed in a year. We also examine two other sources of remuneration that may complement FFS activities: lump-sum payments and side-salaried activities (share of GPs exclusively self-employed, i.e. share of GPs not engaging in any salaried activity in addition to their self-employed practice). As a summary of GP remuneration, we consider labour incomes, defined as net fees (i.e. total fees earned in a year minus professional expenses, such as social contributions, office rents and secretarial services) and wages, if applicable.

Under price regulation, GPs focus on earning more through self-employed practice using complementary remuneration schemes based on capitation rather than through salaried activities. The share of GPs exclusively self-employed remains stable, whereas lump-sum payment levels are markedly higher (+162L%). A complementary analysis shows that GPs receive more lump-sum payments, because they serve more specific cohorts of patients (children) and serve as gatekeepers of patients with chronic diseases, and because male GPs also cover more night and weekend shifts and on-call duties (continuity of care).

Finally, total fees under price regulation are higher for men (+36L%), due to combined effects on the volume of care and on lump-sum payments, but these are not significantly different from those without price regulation for female GPs, as the latter do not increase their workload levels as much as male GPs do. At the end, GP labour incomes are higher for male GPs (+22L%) and lower for female GPs (although estimates are not stable across specifications). This result confirms that male GPs react more to income effects than female GPs (Rizzo and Zeckhauser, 2007).

5.3. Secondary outcomes

We examine changes in GP prescribing behaviours and patient groups. Under price regulation, male GPs prescribe more. This is not the case for female GPs. The annual drug prescription per patient by male GPs is 49L% higher and the annual prescription per patient is 22L% higher. These changes in prescribing behaviours may reflect the fact that male GPs engage in shorter visits (the increase in care provision may not be entirely offset by an increase in the number of hours worked) or attempt to retain patients (if patients believe that GPs who prescribe more provide higher care quality). These prescribing behaviours by contrast are not likely to reflect specific changes in patient groups. GPs do not serve patients with chronic conditions, who would need more

17Assuming that errors in the log outcomes are homoskedastic among treated and non-treated GPs, we can compute effects on outcome levels (Manning, 1998): under price regulation, the number of medical procedures is \( \exp(0.61) - 1 \times 3,540 = 3,009 \) higher, where 3,540 is the average number of medical procedures for sector 2 GPs who established a practice in 1989, immediately prior to the reform; the number of new patients is \( \exp(0.42) - 1 \times 1,204 = 626 \), who are seen 2.9 times on average. This concerns 2.9 \times 626 = 1,815 procedures, that is, 60% of 3,009.

18Gatekeeper GPs receive €40 per year for each patient with a chronic disease

19Prescriptions include drug prescriptions (50%), prescriptions for laboratory tests and diems for sick days.

20Although the quality of care provided is likely to change as well, we cannot study this dimension as we do not observe quality indicators.
prescription renewals more often.\textsuperscript{21} Male GPs treat young patients more often, which is consistent with the increase in lump-sum payments and low-income (CMUC) patients. Female GPs treat elderly patients less often.

5.4. Sensitivity checks

Our results are not sensitive to the robustness checks that we performed: changes of bandwidth (+1/−1 year), addition of covariates in regressions (gender, experience, experience squared and marital status)\textsuperscript{22} and falsification tests.

We now examine the possibility of threshold manipulation in greater depth. Negotiations between PHI, physicians’ unions and the government entailed a period of legal uncertainty prior to full implementation of the reform. Indeed, a convention proposing a free sector choice was signed in July of 1989 by PHI and physicians unions, but the government did not approve it by the end-of-November deadline. Hence, this convention became null and void. The government approved a new convention in March of 1990 that specified new rules for accessing sector 2. As a consequence, physicians who opened practices from July to November of 1989 freely chose their sector. Those who opened practices from December of 1989 to March of 1990 were only permitted to sign a sector 1 contract at first. These GPs were required to wait for the government to reach a decision regarding new means of accessing sector 2. After March of 1990, these GPs were given a month to switch sectors if they fulfilled the new conditions. Since then, the new rules have fully applied to GPs who have opened practices after March of 1990. Therefore, the only physicians who may have manipulated the threshold must have suspected that the government would not approve the previous convention at the end of November; we would have to look for them among those who opened practices in November. Second, treatment effects for GPs who opened practices from December to March may differ slightly from the others; they were exposed to the period of legal uncertainty just mentioned. We conducted tests using the 2008 data, in which the month of practice establishment is available, to determine whether our main results were stable with the inclusion or omission of (i) GPs who opened practices in November or (ii) GPs who opened practices from December of 1989 to March of 1990.\textsuperscript{23} We found very similar results to those presented earlier, although effects on prescriptions were no longer significant.

Detailed results on all these sensitivity checks and the subsequent discussion are presented in the online appendix.

6. DISCUSSION

This section relates the reform to the market structure. Sector 1 and sector 2 GPs faced similar changes in regulation from 1990, the year of reform implementation, to 2005 and 2008, the years of observation (namely, increases in reference prices and extensions of new remuneration schemes for on-call duties and services for specific patients). Only some marginal changes may have affected both groups differently.\textsuperscript{24} However, during that period, GPs who were not constrained by the reform may have strategically responded in terms of activity, and fees for free-billing GPs, to the arrival of new sector 1 GPs (compliers). The equilibrium effects induced by these strategic reactions are likely to be limited as the share of sector 2 GPs has always been small (less than 1% of never-takers and 10.6% of compliers in 1990). They also depend on the market structure and on the consequences of patients’ (heterogenous) preferences on the demand function. Namely, patients may interpret the sector 2 attribute as a signal of quality or the sector 1 attribute as a signal of ethical motivation. If the

\textsuperscript{21}Detailed results are available in the online appendix.

\textsuperscript{22}Covariates enable us to eliminate bias that might result from the inclusion of periods remote from the date of the reform (Imbens and Lemieux, 2008).

\textsuperscript{23}We do not use the month as running variable in the main analysis, as (i) we do not have enough observations per month to conduct a robust analysis; (ii) this variable exhibits a high degree of seasonality; and (iii) we have less confidence in this variable than in the year of practice establishment, as the distribution of the number of new GPs per month differs from that found in other data sets.

\textsuperscript{24}See the online appendix for details.
demand is fully segmented (i.e. patients clearly prefer one type of GP), the new regulation affects sector 1 GPs who may face higher degrees of competition and sector 2 GPs who may then benefit from entry barriers. If not, sector 2 GPs may also intensify their activities and decrease their prices more than they would have done had the reform not taken place.

To examine such equilibrium effects, we use another data set, the French self-employed GPs Panel, which concerns 1/12 of GPs and which is drawn from CNAMTS administrative files, for the 1990–2008 period. Results confirm that sector 2 GP activity is positively influenced by the local share of sector 1 GPs, and sector 2 GP prices are negatively influenced by this variable. Hence, demand is not likely to be fully segmented. Moreover, we performed similar FRD analyses for outcomes common to both data sets and for dates closer to the reform year, separately estimating effects for each experience group. Price regulation impacts vary according to GP experiences. The additional level of care provided by sector 1 GPs relative to what they would have supplied in sector 2 is higher at the start of GP careers, in the 5 years following the reform. This diminishing impact is likely to reflect equilibrium effects (sector 2 GPs adapting their behaviours to more competition from sector 1 GPs) and changing effects of experience (long-term vs short-term effects). For both reasons, the effects of price regulation that we measure for 2005–2008 may underestimate the short-term effects that we would likely have estimated for the earlier years. Surprisingly, we also find that the gap in prices between sector 1 and sector 2 GPs tends to increase with levels of experience, whereas it should decrease over the years if sector 2 GPs had adjusted their prices to those of the competition. In contrast, this illustrates the fact that sector 2 GPs use their prices as a signal of quality and increase extra fees with their level of experience, whereas sector 1 GPs cannot.

In responding to efficiency concerns, it might be appropriate to perform a cost–benefit analysis. This falls beyond the scope of the present paper, as the benefit side is not observed, and FRD methods only enable us to identify local treatment effects. However, we can offer some intuitive conclusions for the cost side. If GPs no longer bill freely, patients (or complementary and supplementary healthcare insurance providers) pay less for each service. There are transfers from physicians to patients. However, physicians provide more services, affecting national health accounts and, therefore, patients. Overall, total fees earned by a GP provide insight into aggregate costs. If these fees had remained stable, the reform would have been socially neutral. The decline in extra fees would have been offset by the increase in the provision of care. Our results show by contrast an increase in total levels of fees for male compliers. Hence, putting aside equilibrium effects, the total amount paid by the collectivity is likely to be higher under overbilling restrictions.

Overall, although our results have no external validity, this evaluation will be of interest for any regulator aiming to control the volume of extra fees, as is the case in most FFS healthcare systems. When GPs react strongly to income effects, complementary remuneration schemes based on capitation (such as lump-sum payments) may compensate for a part of income losses flowing from fee cuts. If these payments are high enough, they can promote changes in GP behaviours, ensuring more continuity of care and a higher accessibility, while reducing supply-induced demand.

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25Our sample contains 2,540 GPs observed each year between 1990 and 2008.
26Changes in prescription behaviours should also be taken into account in a cost–benefit analysis.
(Paris, March 2014) and participants in the Fifth Australasian Workshop of Econometrics and Health Economics (Fremantle, April 2014) for useful comments and discussions. Any opinions expressed herein are those of the authors and not of any institution.

REFERENCES


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